COOPERATIVE CENTRAL AND SOUTHEASTERN US INTEGRATED SEISMIC NETWORK - SLU

Award Number 01HQAG0015

Robert B. Herrmann
Department of Earth and Atmospheric Sciences
Saint Louis University
3507 Laclede Avenue
St Louis, MO 63103
TEL: 314 977 3120
FAX 314 977 3117
Email: rbh@eas.slu.edu

Program Element: Seismic Networks

Final Report

Submitted
July, 2005

Research supported by the U.S. Geological Survey (USGS), Department of the Interior, under USGS award number (Recipient, insert award number). The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

COOPERATIVE CENTRAL AND SOUTHEASTERN US INTEGRATED SEISMIC NETWORK - SLU

Award Number 01HQAG0015

Robert B. Herrmann
Department of Earth and Atmospheric Sciences
Saint Louis University
3507 Laclede Avenue
St Louis, MO 63103
TEL: 314 977 3120
FAX 314 977 3117
Email: rbh@eas.slu.edu

Abstract

This report addresses routine operation and maintenance of the SLU component of the Cooperative Central and Southeastern US Integrated Seismic Network, a cooperative effort between the University of Memphis (CERI), St. Louis University and the U.S. Geological Survey. Significant portions of the proposal are identical between cooperating institutions with local specifics discussed in the Project Plan. The purposes of the networkare twofold:

1. provide scientists, engineers, public and private entities, emergency responders, and the media with rapid and reliable information about felt and damaging earthquakes within a timeframe that maximizes the utility of the information.

2. provide high quality data on a timely basis to the scientific and engineering communities for the purpose of improving:
   a) seismic hazard estimation for urban population centers and the lifelines and critical facilities upon which they depend
   b) estimation and measurement of strong ground motions
   c) our understanding of the basic earthquake process and seismotectonics of earthquake zones, particularly in intraplate regions.

COOPERATIVE CENTRAL AND SOUTHEASTERN US INTEGRATED SEISMIC NETWORK - SLU

Award Number 01HQAG0015

Robert B. Herrmann
Department of Earth and Atmospheric Sciences
Saint Louis University
3507 Laclede Avenue
St Louis, MO 63103
TEL: 314 977 3120
FAX 314 977 3117
Email: rbh@eas.slu.edu

Non-Technical Abstract

This report addresses routine operation and maintenance of the SLU component of the Cooperative Central and Southeastern US Integrated Seismic Network, a cooperative effort between the University of Memphis (CERI), St. Louis University and the U.S. Geological Survey. Significant portions of the proposal are identical between cooperating institutions with local specifics discussed in the Project Plan. The SLU portion consists of digital broadband stations in Missouri, Arkansas, Tennessee, Alabama, Illinois and Indiana to monitor seismicity in the region surrouding the New Madrid Seismic Zone. Information about the seismic network, earthquake history and earthquake damage can be found at the web site:

http://www.eas.slu.edu/Earthquake_Center/

Introduction

This addresses the operation of the SLU component of regional seismic networks within the ANSS Mid-America region. This is the largest ANSS region in the contiguous United States and includes the locations of the significant 1811-1812 New Madrid and the 1886 Charleston, South Carolina, earthquakes. The geographical delineation also includes similar geological features that affect ground motion, such as the deep sediment deposits near New Madrid and the coastal plains.

Saint Louis University Operations

Saint Louis University operates broadband, short-period and strong-motion stations within a portion of the ANSS Mid-America region.

The 3- and 6-channel broadband stations are installed surrounding the active seismic areas of the central Mississippi Valley with USGS stations in Missouri (SLM, FVM, PVMO), Arkansas (UALR), Alabama (PLAL), Tennessee (UTMT, MPH), Indiana (USIN, BLO) and Illinois (SIUC, OLIL Saint Louis University also operates and maintains IRIS stations at CCM, WVT and WCI. All these digital data are archived at IRIS with quality controlled continuous data deposited with in 5 days of recording.

Short period monitoring focuses on the St. Louis and Cape Girardeau areas and uses standard components. New digital strong motion stations focus on the metropolitan St. Louis area, and the broader region of the southern part of the Illinois Basin.

Saint Louis University forwards all data streams in real time to USGS (Golden) and to the ANSS Mid-America region al processing center at the University of Memphis for location.

The focus of Saint Louis University has been to monitor the broader region of seismic activity in the central Mississippi Valley. The instrumental seismicity (1975 – 1990) and regional broadband stations using Quanterra dataloggers are shown in Figure 1. This deployment was selected to provide an economical coverage of a large region, to provide quality data streams for rapid location, for quantitative source parameter determination and for quality research. This network originally forwarded real time data to the USGS Golden through the virtual data logger software, but now sends everything to the USGS-Golden and to the ANSS mid-America data center in Memphis using Earthworm packets.

Real time data transmission is by satellite (PLAL) using DACOMMO/COMSERV, direct Internet (SIUC, UTMT, SLM) using DACOMMO/COMSERV, ISDN (PVMO,FVM) using DACOMMO/COMSERV, earthworm packets (BLO, UALR, MPH, UDIN) and satellite (WCI, CCM, WVT) using DACOMMO/COMSERV to GSN/ALQ. Although complicated, the different technologies permit a significant degree of robustness in that some of the data will always be accessible.

The stations are part of the USGS funded regional networks and Dr. Brian Mitchell's implementation of BILLIKEN - A Broad-Band Intracratonic Large-aperture, Low-noise, Informational, Kooperative, Earth-observing Network in the central United States. His is a cooperative effort with the USGS and IRIS. In the region surrounding the New Madrid Seismic Zone, he has installed stations at Cathedral Cave, Missouri (CCM), Wyandotte Cave, Indiana (WCI) and Waverly, Tennessee (WVT). The stations have Quanterra digitizers, STS-1 sensors and VSAT telemetry. Additional BILLIKEN stations with STS-2 sensors are operating in central Kansas (CBKS) and southwestern Wisconsin (JFWS). The stations sites were selected for low noise so that they would be of *global* network quality while also recording regional and local earthquakes. Allocation of resources by the department provides operational support for these nearby stations, in addition to the support provided by their participation in the USNSN and IRIS networks.

During the summer of 2002, Saint Louis University installed ANSS urban hazard instrumentation at sites in Missouri, Illinois, Indiana and Ohio and installed a number in the St. Louis metropolitan area during the summer of 2003. The locations of these stations are shown in Figures 2 and 3. The 2002 deployment of strong motion stations focused on southeastern Illinois and west-central Ohio – regions of large earthquakes in the historical record. The southern Illinois stations provide rapid location capability as well as provide direct ground motion recordings in the greater Evansville, Indiana, area.

The 2003 focus on St. Louis acknowledges the fact that this urban area cannot be monitored sufficiently to create urban shake maps. At the same time it is possible to sample a variety of surface environments that affect shaking – the glacial plains on Illinois, the major river valleys, and weathered paleozoic strata. The 2002 free-field deployment places instruments cooperative with local colleges: Southern Illinois University Edwardsville, Belleville Area Community College, Maryville University, St. Charles Community College, and Jefferson County Community College in High Ridge. The array along US-40/I-64 may serve as a focus for future NEHRP projects to delineate characteristic geotechnical material properties in the area.

The SLU effort has been directed toward the phasing out of analog systems with replacement by completely digital systems (broadband and accelerograph) that are widely distributed. This approach to broad regional monitoring has paid off by significantly improved location capabilities for the USGS NEIC in this part of the U.S. In addition, the broadband stations have been used together with other national broadband instruments to determine focal mechanisms, depth and moment magnitude from waveform inversion and surface-wave spectral amplitude data.

We are proud of the fact that all digital broadband data are calibrated, that the data flow to NEIC for their use in location, and that we deposit SEED datasets in the IRIS DMC within 5-7 days.

Our biggest problem has been with computer networking and with the sensors.

Networking interruptions affect the real time data flow, but our field systems which have internal storage in the Quanterra' s and the adjacent SPARCS provides sufficient redundancy to permit archiving a continuous data stream. Other redundancy exists is the various Earthworm data flows from each unit, e.g., so that if the SLU data center is not accessible, the data will still flow to the alternate data centers.

A number of the broadband sensors were repaired after a lengthy delay for shipment to and testing in California and then return to the factory in England. We are committed to the full network, and can actually increase the number of sites now since we will have 3 spare Q380's because of the upgrade of SIUC, USIN to 6-component recording with Q330's. The third site will be OLIL . By the end of summer 2004, the sites at MPH, PVMO, SIUC, USIN and OLIL will have 6 channel Quanterra data loggers recording from broadband and acceleration sensors. In addition the broadband SLM station is co-located with a Guralp accelerometer so that 6 sites will be closer to ANSS standards.

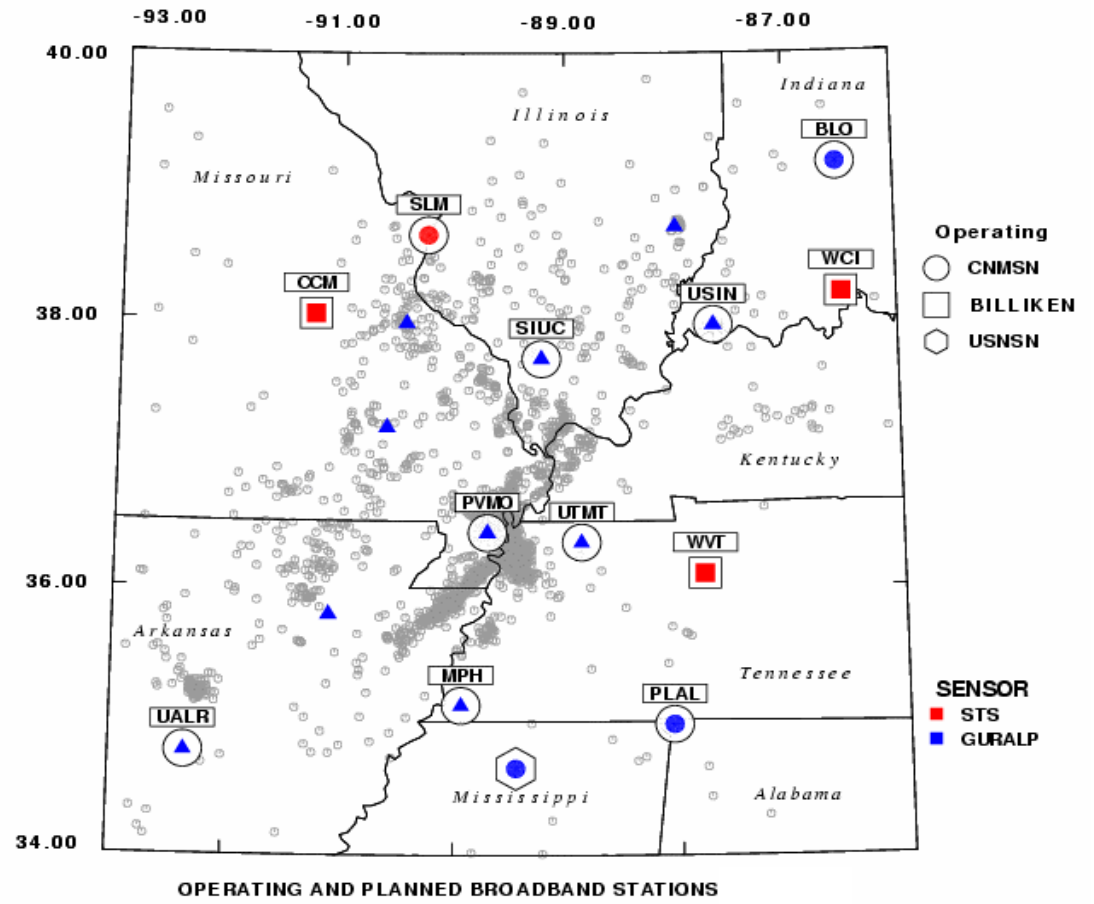

Figure 1. Broadband seismic stations within the ANSS-MA region. The CNMSN and Billiken (IRIS) stations are operated and maintained by SLU. The stations in Olney, Illinois (NNW of USIN) and FVM (east of CCM) will be operating by the end of summer, 2004. There will then be six component recording (broadband plus accelerations) at SLM, MPH, PVMO, SIUC, OLIL and USIN.

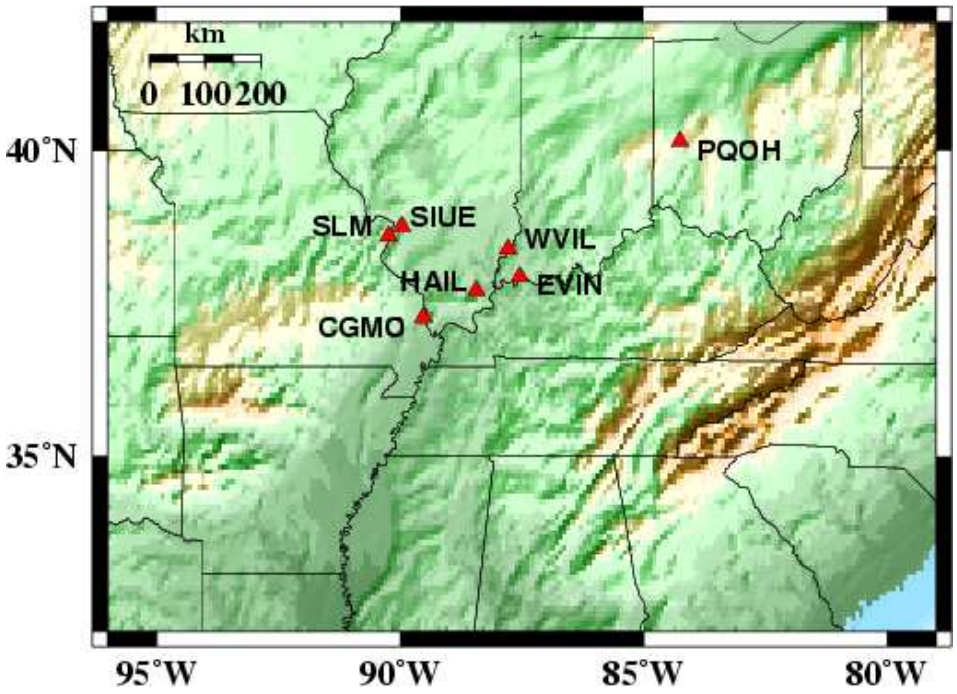

Figure 2. Locations of strong motion stations installed during the summer of 2002

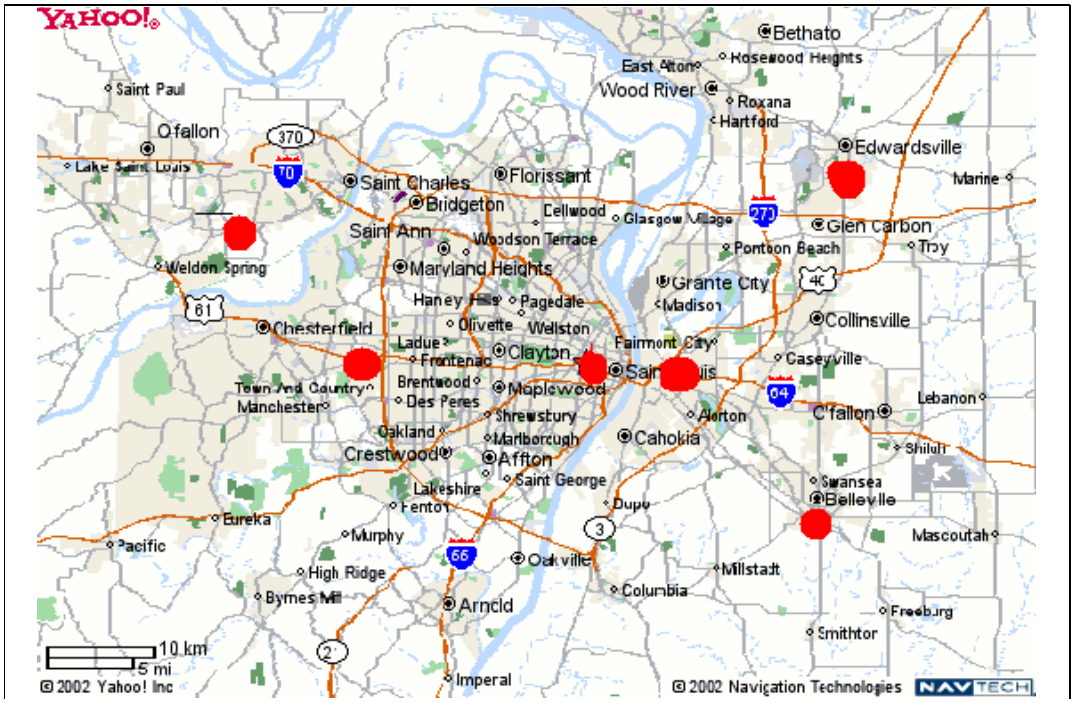

Figure 3. Proposed sites for ANSS urban hazard monitoring installation during the summer of 2003.

Real-time data for location are being sent to the regional processing center in Memphis and to the NEIC at the USGS Golden. All broadband data are calibrated and are being archived at IRIS, with reviewed waveforms submitted within 7 days.
Broadband data are also available in MiniSEED at

http://mnw.eas.slu.edu/Earthquake_Center/NM/data_archive/

Calibrations are available from IRIS and in a dataless SEED format from our website.

References:

All information about the network including station location, calibration, data access are available at the link:

http://www.eas.slu.edu/Earthquake_Center/

This also provides links to photographs of earthquake damage, software, source studies and regional earthquake history.

http://www.eas.slu.edu/Earthquake_Center/NM/bbsta.html

This is the primary link concerning the the digital data stream, station history, and data

analysis . Of particular interest is the effort of determining earthquake source parameters from the broadband data sets given by the link

http://www.eas.slu.edu/Earthquake_Center/NEW/mechanism.html